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Illinois
Nature Preserves Commission

VEGETATION MANAGEMENT GUIDELINES

Spotted Knapweed (*Centaurea maculosa* Lam. syn *C. biebersteinii* DC.)

SPECIES CHARACTER

DESCRIPTION

Spotted knapweed is a biennial or short-lived perennial forb of the Asteraceae (aster family). Leaves are alternate, pale, have a rough surface and are 2.5 - 8.0 cm (1 - 3.2 inches) in length. Upper leaves tend to be linear in shape and lower leaves have margins that are indented about half way to the midrib. Stems are hairy, erect, branching and grow from 30 - 100 cm inches (12 - 40) in height. The root is a stout, elongated taproot. Flowers are pinkish-purple, thistle-like and bloom from late June through early October in northern Illinois. The heads are up to 2.0 cm (0.8 inches) in diameter and surrounded by stiff, black-tipped bracts that give it a spotted appearance. They occur singly and are mainly terminal. Seeds are brown, usually less than 0.5 cm (0.2 inch) in length, notched on one side of the base and have a short tuft of bristles at the tip that enables wind dispersal.

SIMILAR SPECIES

Similar species include bachelor's button (*C. cyanus*), white-flowered knapweed (*C. diffusa*) and Russian knapweed (*Centaurea repens*). Bachelor's button is an annual or winter perennial with narrow, usually unlobed leaves, and blue flowers. White-flowered knapweed is a diffusely branched annual or biennial with small leaves and white flowers. Russian knapweed is a bushy-branched perennial with unlobed leaves and purple flowers. Spotted knapweed should be positively identified before attempting any control measures. If identification of the species is in doubt, the plant's identity should be confirmed by a knowledgeable individual by consulting appropriate plant identification manuals or keys.

DISTRIBUTION

Spotted knapweed is native to Europe and is found throughout Europe and western Asia, It was introduced into North America in the late 1890s from contaminated agricultural seed. It is a serious problem in the rangelands of the northwest United States and southwest Canada and is showing an increasing presence in natural areas. It is estimated that spotted knapweed infests over 4 million hectares (10 million acres) across North America.

HABITAT

In its native range, spotted knapweed inhabits dry continental vegetation types and disturbed areas. In North America, the species has historically inhabited heavily disturbed areas such as rangelands, agricultural fields, roadsides, and waste ground. More recently, the species has been found to invade relatively undisturbed natural areas such as dry prairies and sand

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communities. Regardless of habitat, human activities and soil disturbance remain an integral part of the establishment and spread of spotted knapweed.

LIFE HISTORY

Spotted knapweed reproduces mainly by seed, but can also reproduce vegetatively from lateral root shoots and live for over 9 years. Knapweeds overwinter as rosettes or seeds. Seedlings develop into rosettes, producing maximum root growth at this stage. Plants that overwinter as rosettes usually bolt in the spring, but plants may persist in the rosette stage for 4 or more years before developing a floral stalk.

Spotted knapweed is self-compatible and flowering begins in late June in northern Illinois. Flowers are insect pollinated and mature seed may begin to form by about mid-August. Seed production (~1000 seeds/plant) and viability (~90%) are high and seeds can remain viable (~40% viability) in the soil for at least 5 - 8 years. Most seeds fall near the parent plant, but they can also be dispersed by wind, water, animals, people, and objects (e.g. vehicles).

Seeds are of three germination types: non-dormant seed that germinates regardless of light; seed with dormancy set by far-red light and broken by far-red light; and dormant seed that does not germinate until after burial. Since chlorophyll absorbs red light, most seeds (>90%) in stands of spotted knapweed germinate in the spring while seeds on bare soil germinate in the fall. Spotted knapweed seeds have an elaiasome (oil-rich appendage) that is eaten by ants after the seed is transported back to the nest. After the elaiasome is eaten, the undamaged seeds are discarded in an underground gallery where they can remain viable for up to 12 years. After these buried seeds are uncovered, germination rates can be as high as 85% and infestations may occur several years after vegetative plants have been eliminated.

In undisturbed grasslands, arbuscular mycorrhizal fungi (AMF) are present in grasses and spotted knapweed. The assimilate transfer of nutrients via AMF is to the strongest metabolic sink, spotted knapweed. Non-lethal control measures, such as cutting, mowing and spot treatment with herbicide, can weaken spotted knapweed and give a competitive advantage to native grasses.

EFFECTS UPON NATURAL AREAS

Spotted knapweed can invade disturbed sites, especially those with drier soil conditions. Establishment of spotted knapweed often results in high stem densities that causes reduced native plant diversity and vigor within natural communities. Spotted knapweed contains lactones and cnicin that inhibited growth of some plants in laboratory tests; however these results have not been replicated in the field studies.

CONTROL RECOMMENDATIONS

RECOMMENDED PRACTICES IN NATURAL COMMUNITIES OF HIGH QUALITY

The long-term viability of knapweed seed will require repeated application of control techniques and monitoring for several years once a population becomes established. A combination of techniques (such as removal and burning of above ground portions followed by herbicide application) may provide the most intensive and effective control. Regardless of the treatment method chosen, careful follow-up is necessary. **Many attempts to control spotted knapweed have failed because follow-up treatments were not applied consistently.**

Mechanical control

Hand-pulling is effective in controlling small infestations of knapweed. Plants must be pulled annually before seed set until the seedbank is exhausted. The entire plant should be pulled to prevent resprouting from roots. As with any hand-pulling activity, gloves should be worn and care should be taken to protect the skin from abrasions or other trauma.
Repeated mowing or cutting of plants can be effective in reducing seed production by reducing the number of seed producing plants. Cutting should be done several times during the growing season and before seed production begins. Once seeds begin to develop, cut plants should be bagged and removed from the site and disposed of or burned in a very hot fire.

Chemical control

Clopyralid (trade name Transline or Stinger) provides effective control with little soil residual when applied at a rate of 0.25 lb active ingredient per acre (0.28 kg/ha). Applied at these rates, clopyralid should not significantly reduce native forb diversity or density. Foliar application can be done at any stage of plant growth. Re-application may be necessary every year until the seedbank is exhausted. Care should be taken to avoid non-target species. **Do not spray so heavily that herbicide drips off the target species.** Herbicide should be applied while backing away from the treated area to avoid walking through wet herbicide. By law, herbicides should only be mixed and applied according to label instructions and applied by licensed herbicide applicators or operators while working on public properties.

Clopyralid + 2,4-D (trade name Curtail) is an effective control for knapweed with little soil residual when applied at a rate of 0.19 lb active ingredient per acre (0.21 kg per ha; clopyralid) and 1.0 lb active ingredient per acre (1.12 kg per ha; 2,4-D). The application rate for Curtail is 4.16 lb product per acre. For handheld or backpack application over small areas, use one to two ounces per gallon of water. Foliar application should be done during the bolting or early bud development stage. Treatment is less effective when applied to the rosette, during flowering or after flowering. Re-application may be necessary every year until the seedbank is exhausted.

2,4-D amine (tradename Five star, Formula 40) or ester (tradename Weedone) can control spotted knaopweed in the rosette stage with an application rate of 1.0 -2.0 lbs active ingredient per acre (1.1 - 2.25 kg per ha). 2, 4-D does not prevent germination of seeds in the seedbank and must applied annually until the seedbank is exhausted. Application after stem elongation is not effective.
Triclopyr (tradename Garlon 3A, Renovate) applied as a 3% solution can provide control and does not affect grasses.

RECOMMENDED PRACTICES ON BUFFER AND SEVERELY DISTURBED SITES

All methods recommended for high-quality communities can be employed on buffer areas and severely disturbed sites.

Additionally, picloram (tradename Tordon) can be used to control Knapweed plants will prevent seed germination for 3 to 4 years after application when applied at the rate of 0.25 pounds/acre after stem elongation or 1 pound/acre during the rosette stage. For handheld or backpack application over small areas, use one to two ounces per gallon of water. Tordon does not affect native grasses, but can have long term effects on trees and shrubs. Tordon will remain in the soil for several years and contaminate ground water. Tordon should not be applied near

water, on porous soils overlying groundwater, or in areas where the water table is shallow. It may be cost prohibitive to apply Tordon to large areas.

Dicamba (tradename Banvel, Trooper) applied at the rate of 1 to 2 pounds/acre control of knapweed plants prevent seed germination. For handheld or backpack application over small areas, use one to two ounces per gallon of water. Dicamba will persist in the soil for a shorter period of time than Tordon, so follow-up treatments may be needed to control seedlings. Dicamba is also costly to apply.

BIOLOGICAL CONTROL

Biological control agents have been used on spotted knapweed since about 1970. Spotted knapweed is a host to several insects and 11 species have been introduced to North America as biological control agents. Root feeders are weevils (*Cleonis pigra*, *Cyphocleonus achnates*), moths (*Agapeta zoegana*, *Pterolonche inspersa*), and a beetle (*Sphenoptera jugoslavia*). Seed-head agents are weevils (*Bangasternus fausti*, *Larinus minutus, L. obtusus*), flies (*Terellina virens, Chaetorellia acrolophi, Urophora affinis* and *U. quadrifasciata*) and a moth (*Metzneria paucipunctella*).

A few endemic insects feed upon spotted knapweed, but are generalists that do little harm to the plant. Biological control efforts have been aimed at vast knapweed infestations that dominate economically important rangelands and met with mixed success. Application of this technique may not be appropriate or feasible within natural communities at this time as most knapweed populations in these communities tend to be small.

FAILED OR INEFFECTIVE PRACTICES

Prescribed burning alone is not effective in controlling spotted knapweed. Prescribed burning does not appear to effect the rosettes, prevent crowns from resprouting, nor significantly impact viable seed in the soil. Prescribed burning may promote more vigorous stands of native grasses and will remove above ground biomass that could render herbicides more effective.

Grazing is not an effective control for spotted knapweed. Spotted knapweed contains cnicin, a bitter substance that suppresses rumen activity in livestock; thus livestock tend to avoid spotted knapweed except in overgrazed pastures. The overgrazed conditions that promote grazing of spotted knapweed also promote favorable conditions for the establishment and spread of the plant. Seeds may also be transported in the coats of livestock. As much as 26% of seeds eaten and passed by sheep and deer remained viable. Defoliation of grass by grazing might also increase assimilate transfer of nutrients via AMF to spotted knapweed.

Mowing and cutting spotted knapweed can be ineffective if timed improperly or if too few cuttings are made. If cut only once or too early in development, cut plants may generate new flowering stems. These plants will produce fewer seed heads per stem, but might produce a greater number of stems. The net result is that overall seed production remains about the same as in uncut plants. Mowing after seeds are mature will disperse seeds over a wider area.

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